《科学》（20250502出版）一周论文导读

作者：writer 来源：科学网

本文原地址：https://www.iikx.com/news/progress/33153.html

《科学》（20250502出版）一周论文导读。Science, 2 May 2025, Volume 388 Issue 6746

《科学》2025年5月2日，第388卷，6746期

物理学Physics

Geometrically frustrated rose petals

几何上受挫的玫瑰花瓣

▲ 作者：YAFEI ZHANG, OMRI Y. COHEN, MICHAEL MOSHE, AND ERAN SHARON

▲ 链接：https://www.science.org/doi/10.1126/science.adt0672

▲ 摘要：生长和形态是紧密相连的，以一种由几何不相容引起的机械不稳定性作为媒介。虽然高斯不相容一直被认为是自然生长的细长器官变形的来源，但在这里，研究表明玫瑰花瓣的生长轮廓仍然是高斯相容的。它们独特的形状源于一种不同类型的几何不相容，即MCP不相容，这导致花瓣边缘形成局部尖。

研究者从理论上、计算上和实验上验证了这一机制。研究揭示了不同的形态机制，从光滑的边缘到尖端形成的配置，并展示了应力集中在尖端如何影响随后的花瓣生长。这些发现表明MCP不相容是天然和人造自变形片尖形成的一般机制。

▲ Abstract：Growth and form are deeply interconnected, in a manner often mediated by mechanical instabilities arising from geometric incompatibilities. Although Gauss incompatibility has long been recognized as the source of morphing in naturally growing slender organs, here we show that the growth profile of rose petals remains Gauss compatible. Their distinctive shape emerges from a different type of geometric incompatibility, the Mainardi-Codazzi-Peterson (MCP) incompatibility, which leads to the formation of localized cusps along the petal margins. We validated this mechanism in model disc petals theoretically, computationally, and experimentally. Our study reveals distinct morphological regimes, ranging from smooth edges to cusp-forming configurations, and demonstrates how stress focusing at cusps influences subsequent petal growth. These findings position MCP incompatibility as a generic mechanism for cusp formation in both natural and manmade self-morphing sheets.

Electron collision in a two-path graphene interferometer

双路石墨烯干涉仪中的电子碰撞

▲ 作者：H. CHAKRABORTI, L. PUGLIESE, A. ASSOULINE, K. WATANABE, T. TANIGUCHI, N. KUMADA, D. C. GLATTLI, M. JO, H.-S. SIM, AND P. ROULLEAU

▲ 链接：https://www.science.org/doi/10.1126/science.adn4622

▲摘要：两个电子在分束器上的碰撞为研究它们的相干性和不可区分性提供了一种方法。它的实现需要单电子的按需生成和同步。研究者展示了由电压脉冲产生的单电子在石墨烯马赫—曾德干涉仪中的相干碰撞，通过测量碰撞产生的散粒噪声，揭示了碰撞电子的基本特征，突出了它们波函数中不可区分部分和可区分部分之间的互补性。

前者通过费米子Hong-Ou-Mandel相消干涉表现出来，后者通过噪声中的双绕组Aharonov-Bohm相消干涉表现出来。60%左右的干涉可见度使全面的量子态层析成像成为可能。该发现可使涉及飞行量子比特的相干操作在石墨烯中触手可及。

▲ Abstract：The collision of two electrons at a beam splitter provides a method for studying their coherence and indistinguishability. Its realization requires the on-demand generation and synchronization of single electrons. In this work, we demonstrate the coherent collision of single electrons, generated by voltage pulses, in a graphene Mach-Zehnder interferometer. By measuring shot noise resulting from the collisions,

we unveil fundamental characteristics of colliding electrons, highlighting the complementarity between the indistinguishable and distinguishable parts of their wave functions. The former is manifested through fermionic Hong-Ou-Mandel destructive interference, whereas the latter is discerned through double-winding Aharonov-Bohm interference in the noise. The interference visibilities of around 60% enable comprehensive quantum state tomography. Our findings may place coherent operations involving flying qubits within reach in graphene.

化学Chemistry

Formation of hydrided Pt-Ce-H sites in efficient, selective oxidation catalysts

高效、选择性氧化催化剂中氢化Pt-Ce-H位点的形成

▲ 作者：JI YANG LORENZ J. FALLING, SIYANG YAN, BILUAN ZHANG, PRAGYA VERMA, LUKE DAEMEN, YONGQIANG CHENG, XIAO ZHAO, SHUCHEN ZHANG, AND JI SU

▲ 链接：https://www.science.org/doi/10.1126/science.adv0735

▲ 摘要：单原子位催化剂可以提高许多催化反应的速率和选择性。研究者通过将Pt1/CeO2单位点与分子基团和载体的氧空位结合来修饰它们。

新的位点包括氢化位点（Pt2+-Ce3+H δ?）和羟基化位点（Pt2+-Ce3+OH），这些位点在几个反应中表现出更高的反应活性和选择性，其中一氧化碳氧化反应速率提高了9倍，丙烷氧化脱氢丙烯选择性提高了2.3倍。用原位、非原位光谱技术和理论方法测定了这些位点的原子结构和反应步骤。

▲ Abstract：Single-atom site catalysts can improve the rates and selectivity of many catalytic reactions. We have modified Pt1/CeO2 single sites by combining them with molecular groups and with oxygen vacancies of the support. The new sites include hydrided (Pt2+-Ce3+H δ?) and hydroxylated (Pt2+-Ce3+OH) sites that exhibit higher reactivity and selectivity to previous single sites for several reactions, including a ninefold increase in the reaction rate for carbon monoxide oxidation and a 2.3-fold improvement of propylene selectivity for oxidative dehydrogenation of propane. The atomic structure and reaction steps of these sites were determined with in situ and ex situ spectroscopy techniques and theoretical methods.

A self-regenerating Pt/Ge-MFI zeolite for propane dehydrogenation with high endurance

高耐久丙烷脱氢用自再生Pt/Ge-MFI沸石

▲ 作者：HUIZHEN HONG, ZHIKANG XU, BINGBAO MEI, WENDE HU, PAOLO FORNASIERO, CHUANMING WANG, TINGHAI WANG, YUANYUAN YUE, TIESEN LI , AND XIAOJUN BAO

▲ 链接：https://www.science.org/doi/10.1126/science.adu6907

▲ 摘要：负载型贵金属团簇催化剂通常在包括还原和氧化气氛之间切换的恶劣条件下运行，导

致催化剂结构的不可逆转变，从而导致永久失活。研究者发现各种铂（Pt）前驱体在锗-MFI（Ge-MFI）沸石中自发分散，与Ostwald成熟现象对立，产生自再生的铂/Ge-MFI丙烷脱氢催化剂。这些催化剂可在还原反应和氧化再生条件下可逆地在铂簇和铂单原子之间切换。

这种环境适应性使它们能够在丙烷脱氢过程中进行110多个反应和再生循环，并在800°C的空气中暴露10天，表现出前所未有的抗烧结性能。这种锗-
MFI沸石的自发金属分散，是一种制造铑、钌、铱和钯簇催化剂的强大、通用方法。

▲ Abstract：Supported noble metal cluster catalysts are typically operated under severe conditions involving switching between reducing and oxidizing atmospheres, causing irreversible transformation of the catalyst structure and thereby leading to permanent deactivation. We discovered that various platinum (Pt) precursors spontaneously disperse in a germanium-MFI (Ge-MFI) zeolite, which opposes the Ostwald ripening phenomenon, producing self-regenerating Pt/Ge-MFI catalysts for propane dehydrogenation. These catalysts reversibly switch between Pt clusters and Pt single atoms in response to reducing reaction and oxidizing regeneration conditions. This environmental adaptability allows them to completely self-regenerate over 110 reaction and regeneration cycles in propane dehydrogenation, and they exhibited unprecedented sintering resistance when exposed to air at 800 ° C for 10 days. Such spontaneous metal dispersion in a Ge-MFI zeolite is a robust and versatile methodology for fabricating various rhodium, ruthenium, iridium, and palladium cluster catalysts.

Ecology生态学

North American bird declines are greatest where species are most abundant

在物种最丰富的北美地区，鸟类数量减少最多

▲ 作者：ALISON JOHNSTON, AMANDA D. RODEWALD, MATT STRIMAS-MACKEY, TOM AUER, WESLEY M. HOCHACHKA, ANDREW N. STILLMAN, COURTNEY L. DAVIS, VIVIANA RUIZ-GUTIERREZ, ADRIAAN M. DOKTER, AND DANIEL FINK

▲ 链接：https://www.science.org/doi/10.1126/science.adn4381

▲ 摘要：解决北美鸟类数量下降问题的努力一直受到有关种群变化的精细信息有限的限制。利用eBird的参与式科学数据，研究者估算了2007年至2021年495种鸟类在27公里分辨率下的大陆种群变化和相对丰度。

显示，趋势的空间异质性很高，以前未被发现；尽管75%的物种数量在减少，但97%的物种数量在显著增加和显著减少的区域之间存在差异。在物种最丰富的据点，种群数量往往会急剧下降，但在物种最不丰富的地方，它们的生存状况会更好。

这些高分辨率的趋势提高了人们了解种群动态的能力，优先考虑恢复工作，并在迫切需要采取行动时指导保护。

▲ Abstract：Efforts to address declines of North American birds have been constrained by limited

availability of fine-scale information about population change. By using participatory science data from eBird, we estimated continental population change and relative abundance at 27-kilometer resolution for 495 bird species from 2007 to 2021. Results revealed high and previously undetected spatial heterogeneity in trends; although 75% of species were declining, 97% of species showed separate areas of significantly increasing and decreasing populations. Populations tended to decline most steeply in strongholds where species were most abundant, yet they fared better where species were least abundant. These high-resolution trends improve our ability to understand population dynamics, prioritize recovery efforts, and guide conservation at a time when action is urgently needed.

Adaptation and gene flow are insufficient to rescue a montane plant under climate change

适应和基因流动不足以拯救气候变化下的山地植物

▲ 作者：JILL T. ANDERSON, MEGAN L. DEMARCHE, DEREK A. DENNEY, IAN BRECKHEIMER, JAMES SANTANGELO, AND SUSANA M. WADGYMAR

▲ 链接：https://www.science.org/doi/10.1126/science.adr1010

▲摘要：气候变化日益推动当地人口动态，改变地理分布，并威胁到持久性。基因流动和快速适应可以挽救不断下降的人口，但很少被纳入预测。研究者利用5个普通园林中102272株（115个源种群）的适应度数据，模拟了工业化前、现代和预测气候下的生态进化动态。

研究发现，气候变化危及当地适应的种群，并降低了长期种群增长率的基因型变异，表明适应潜力有限。上坡迁移可以稳定高海拔种群并保持低海拔生态型，但用基因组数据模拟的无辅助基因流动在空间上太受限制。物种分布模型未能捕捉到当前的动态，并且可能高估了中等排放情景下的持久性，这突出了模拟进化过程的重要性。

▲ Abstract：Climate change increasingly drives local population dynamics, shifts geographic distributions, and threatens persistence. Gene flow and rapid adaptation could rescue declining populations yet are seldom integrated into forecasts. We modeled eco-evolutionary dynamics under preindustrial, contemporary, and projected climates using up to 9 years of fitness data from 102,272 transplants (115 source populations) of Boechera stricta in five common gardens. Climate change endangers locally adapted populations and reduces genotypic variation in long-term population growth rate, suggesting limited adaptive potential. Upslope migration could stabilize high-elevation populations and preserve low-elevation ecotypes, but unassisted gene flow modeled with genomic data is too spatially restricted. Species distribution models failed to capture current dynamics and likely overestimate persistence under intermediate emissions scenarios, highlighting the importance of modeling evolutionary processes.

作者：冯维维 来源：科学网微信公众号